RAC
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31 January, 1994.

Dr. William Kemper
7363 West 26 Place
Denver, CO 80215

Dear Dr. Kemper;

As promised in my letter to you, dated January 6, we have started to work on the questions that you submitted to the Health Advisory Panel. Your questions are listed below, and we would appreciate you checking them to see that they have been copied correctly. In some cases the text has been modified slightly for clarity. Could you please expand on question 23, I am not sure what your question is addressing. The numbers in the list refer to the original numbering on your handwritten list, and are no longer in sequential order. The questions have been reordered to reflect the different topic area that they address, and in some cases a response has already been provided. We hope to be able to address a number of these questions directly at the next Health Advisory Panel meeting in March, in the public forum. Other questions will require more research before any answers can be provided. Once again, I very much appreciate your interest in the study.

Yours sincerely,

John E. Till

John E. Till, Ph.D.
President

enc. List of questions

Copy to: *RAC* Team
Dr. Morin, CDH

Questions from William Kemper Concerning the Rocky Flats Dose Reconstruction Project.

Questions to CDH

3. Can CDH make a listing of number of cases (not deaths) of childhood leukemia and thyroid cancer per 100,000 population in Denver, Jefferson, Adams, and Boulder counties and the cities of Evergreen, Golden, Lakewood, Wheatridge, Westminster, North Glen, Arvada, Broomfield, Louisville, Lafayette, Loveland, Greeley, Fort Collins by year 1940 to present?

4. The following question arises perhaps too late, but would the money being spent on the two HAP contractor studies - ChemRisk and *RAC* be better spent on other aspects of cleanup that affect the future?

Questions to Mrs. Abbot

9. I'd like a report on Mrs. Abbot's cattle's birth deformities.

Technical Questions

1. How does the toxicity of U235 compare with that of Pu239? Is it the same on a per Ci basis? If so, since the $^1/_2$ life Pu239 is 2.4×10^4 yr and U235 is 7×10^8 yr, on a per gram basis Pu239 it would be about 3×10^4 times as toxic. The Task 3 & 4 reports suggest U235 was used for weapons almost to the extent of Pu239 up until 1962 (See p. 68 Task 3 & 4). Were all bomb triggers fabricated at RFP after 1962 Pu? Was any U235 in path of '57 or '69 fires? Is any in ductworks or filters? Apparently some were in the oils on Pad 903 (p.68 Task 3 & 4). Is there any in sediment of Standley Lake or Great Western Reservoir? If the answer to the 2nd question is yes, and results of analyses for Pu that we are given are Ci of both U235 and Pu239, I suppose remainder of above questions are not really needed.
Action: John Till
Status: ☐ In hand.
☐ Complete.

2. What is the solubility of the oxides of Pu (which oxide is most stable in the sediment?) in water in the temperature range 32°– 85°F and pH 4,5-8? What is max (85°F, 4.5pH)? What other factors can affect solubility, Ca content?
Action: Neils Schonbeck
Status: ☐ In hand.
☐ Complete.

7. I realize this is unlikely, but is there a possibility of making PuF_6 in the refining of Pu by fluoridation?
Action: Neils Schonbeck
Status: ☐ In hand.
☐ Complete.

23. How does water on a Pu increase criticality risk?
Action: Neils Schonbeck
Status:☐ In hand.
☐ Complete.

29. It might be worth investigating particle size PuO_2 from burning Pu.
Action: Paul Voillequé
Status:☐ In hand.
☐ Complete.

6. In the proposed thermal stabilization of Pu, what if, as in the past, the Pu is contaminated with tritium? Enough to give a hazardous emission of tritiated water?
Action: Bob Meyer
Status:☐ In hand.
☐ Complete.

5. How do you assess the tritium hazard? What are the published limits or standards for tritium in drinking water? In air? I realize tritium has a short half life and residence time in the body, but I'd like to see some evaluation of tritium hazards. Perhaps this is somewhere in reports - If so, where?
Action: Bob Meyer
Status:☐ In hand.
☐ Complete.

11. It has been stated (EIN Newsletter Fall '93) that the Am concentration in bovine tissue of cattle grazing near RFP was $^1/_4$ to $^1/_2$ that of Pu239. Considering that the ratio of Am to Pu in weapons material is so low, how is it that Am is this high? Is the concentration in grams or Ci? Is Am retained more in tissue than Pu? The same report gives .77 pCi/g of U238 in the soil. This seems extremely high considering that U238 is not very active. Please comment.
Action: Sue Rope
Status:☐ In hand.
☐ Complete.

12. How is bi-product Am stored at RFP?
Action: Helen Grogan
Status:☐ In hand.
☐ Complete.

20. Tasks 3 & 4 Report, p. 70 Fig 3-12 shows Am residues after '67 prepared for burial. Where was the Am buried?
Action: Helen Grogan
Status:☐ In hand.
☐ Complete.

15. Do we have a summary of the Church Litigation claims and assertions? These are not in Task 3 & 4 report p. 30 and 31. Was the Church claim ref '57 fire?
Action: Kathleen Meyer
Status:☐ In hand.
☐ Complete.

16. I have been told Harvey Nicols has some information that is of consequence, but is not recorded.
Action: Terrol Winsor
Status:☐ In hand.
☐ Complete.

21. Are ponds B and solar ponds lined with plastic?
Action: Kathleen Meyer
Status:☐ In hand.
☐ Complete.

22. What is Shell-Vitrea (1957 fire Supple. Report)?
- Shell Vitrea is a straight-chain hydrocarbon mineral oil that is used as a lathe coolant when machining plutonium.

Action: Helen Grogan
Status:☐ In hand.
☐ Complete.

24. What are CWS filters?
- These are Chemical Warfare Service (CWS) filters. [To be expanded upon]

Action: Paul Voillequé
Status:☐ In hand.
☐ Complete.

28. What is meant by "Th strikes" Task 2,3 report p. 125?
Action: Terrol Winsor
Status:☐ In hand.
☐ Complete.

Questions Relating to the '57 Fire and Other Accidents and Incidents

25. In the '57 fire was the last filter between outside atmosphere and the ductworks breached? I note Vandegrift Rep., in ref Q26, p60, he states "Outside we could see a large cloud of smoke coming from the stack of 71 Bldg. "Also Venable p. 64 par. 2., p. 66.
Action: Paul Voillequé
Status:☐ In hand.
☐ Complete.

18. I would like more evaluation of the '65 glove box drain fire and the '64 Pu, CCl_4 explosion.
Action: Kathleen Meyer
Status: In hand.
Complete.

8. I'd like to know more abut the 5/1/81 haystack fire. Was the fireman's health subsequently OK?
Action: Terrol Winsor
Comment: EIN Newsletter Fall '93 contains an article on this.
Status: In hand.
Complete.

19. What were the Sr & Co levels in the soil? Can these be accounted for by world wide fallout? Or, are these an indication of criticality at RFP?
Action: Terrol Winsor and Duane Schmidt (Sue Rope)
Status: In hand.
Complete.

RESPONSE TO QUESTION #11 FROM W.A. KEMPER REGARDING ACTINIDE CONCENTRATIONS IN CATTLE GRAZING NEAR THE ROCKY FLATS PLANT

Susan K. Rope
Environmental Perspectives, Inc.
Member of *Radiological Assessments Corporation* Research Team
10 March, 1994.

Restated question:

> "It has been stated (EIN Newsletter Fall '93) that the Am concentration in bovine tissue of cattle grazing near RFP was 1/4 to 1/2 that of Pu239. Considering that the ratio of Am to Pu in weapons material is so low, how is it that Am is this high? Is the concentration in grams or Ci? Is Am retained more in tissue than Pu? The same report gives .77 pCi/g of U238 in the soil. This seems extremely high considering that U238 is not very active. Please comment."

I have reviewed both the Environmental Information Network (EIN) article and the report upon which it was based (Smith and Black 1975). These observations have been prepared to provide a timely response to Dr. Kemper's question, but should not be viewed as the final word from the RAC team on these important points.

The Smith and Black report had previously been identified for review under Task 4 of Phase II (Evaluation of Historical Environmental Data) of the Rocky Flats Dose Reconstruction Project. Although the sample sizes were small (ten animals from Rocky Flats), the study contains important information about measured radioactive forms of Pu, Am, Sr, H, and U in grazing cattle near the RFP (see Figure 1 for location). Concentrations are compared with those measured in cattle from Nevada, both near and distant to the Nevada Test Site (Figure 2). The study is also of interest for the dose reconstruction because the monitoring was performed by an agency (EPA) which is independent of the RFP contractor or the DOE.

Many of the statements in the EIN article are reported directly from the Smith and Black report, although the context and emphasis placed on certain statements perhaps attributes more significance to the results than is justified by the data. I will not critique the EIN article, but rather address the questions raised by Dr. Kemper. I will also add some conclusions of my own on the significance of the results.

First, let's examine the quoted ^{238}U concentration in soil. Smith and Black cite another source (Huffman 1974) for the concentration of 0.77 pCi/g ^{238}U in soil within an arc of 5 miles from the Rocky Flats Plant, and state that the

concentration is about three times the worldwide average of 0.25 pCi/g (Welford and Baird 1967). However, the authors also point out that a relatively high natural uranium content is found in soil from the eastern slope of the Colorado Rockies.

The ^{238}U concentration of 0.77 pCi/g in surface soil is consistent with a background concentration. Myrick et al. (1983) report a nationwide average of ^{238}U in surface soil of 1.0 pCi/g. The range of values measured in 32 background samples from Colorado was 0.47–3.0 pCi/g ^{238}U with an arithmetic mean value of 1.2 and a standard deviation of 0.91. The geometric mean concentration was also 1.2 pCi/g ^{238}U with a geometric standard deviation of 1.4.

Secondly, the reported results of actinide concentrations in the tissues of the cattle were examined. As is the case with many studies of radioactivity in the environment, the concentrations measured were quite low, and statistical interpretations are problematic. The analytical laboratory reported their results in units of activity of each isotope per gram of ash. These original analytical data are reproduced in the Appendices of Smith and Black (1983), and have been copied to Dr. Kemper with this review for his direct examination. Smith and Black convert the concentrations to activity per gram of fresh weight based on the percent ash figures provided by the laboratory for each tissue.

The statement in the EIN article that americium concentrations were about "1/4 to 1/2 of the plutonium–239 concentrations in the same tissues" is excerpted verbatim from the Smith and Black report. The comparison is based on activity concentrations (i.e. pCi isotope/kg tissue), not mass concentrations (i.e. pg isotope/kg tissue).

As a general rule, americium *is* slightly more biologically mobile than Pu, but both are relatively immobile. For example, the root uptake of Am into plants has been stated to be about 10 times higher than for Pu (Linsley et al. 1979; Garten 1978). However, soil-to-plant concentration ratios for uptake of plutonium are very low — ranging from $1 ¥ 10^{-6}$ to $2.5 ¥ 10^{-4}$ (wet vegetation/dry soil), based on radioisotope experiments in plants grown in controlled environments (ATSDR 1990). Contamination of exterior plant surfaces might be expected to be relatively the same for Pu and Am, and can be 100 to 1000 times more than that resulting from root uptake (Romney et al. 1976). Following exposure to the same activity concentration in air, the activity concentration in cow's meat is predicted to be 2.4 times higher for Am than Pu (CEC 1979).

Next, I would like to address the comment, "Considering that the ratio of Am to Pu in weapons material is so low, how is it that Am is this high?" Nuclear weapons testing, which is the largest source of plutonium in the environment, has resulted in environmental contamination with ^{241}Pu as well as ^{240}Pu and ^{239}Pu. The Pu/Am ratio would be expected to vary depending on the amount of ^{241}Am ingrowth from the parent ^{241}Pu, which has a 14.4-yr half-life.

Insight into the magnitude of this ratio in the environment in the mid-1970s is gained from an article by Romney et al. (1976), who examined the ratio of

^{239,240}Pu to ^{241}Am in vegetation in ten areas affected by fallout from the Nevada Test Site (NTS) and the Tonapah Test Range (TTR), (Figure 2). The nuclear tests of interest to these study areas occurred in 1954–1957 at the NTS and in 1963 at the TTR. The Pu/Am ratio was "reasonably constant for vegetation samples collected from a given fallout area. This ratio, however, varied among separate test events primarily as the result of differences in the ingrowth of ^{241}Am within the aged source materials." (Romney et al. 1976). The mean ^{239,240}Pu/^{241}Am ratio in vegetation ranged from 4 to 12 at the NTS areas and from 12 to 17 at the TTR.. The ^{239,240}Pu/^{241}Am ratio was 2–4 in the cattle tissues reported by Smith and Black. This somewhat lower ratio in the tissues might be due to the greater biological availability of Am relative to Pu. The magnitude of this ratio in the Rocky Flats area over time, as well as other data from biological monitoring programs, will be investigated more thoroughly as progress on Task 4 of the RF Dose Reconstruction Project continues.

I would like to finish my comments with some observations about the significance of the measured concentrations. Based on the authors' description of the sampling sites, it would be logical for the cattle obtained from the Searchlight and Reno to be relatively low (the Searchlight herd grazes on a range "which has been exposed only to worldwide fallout and the natural radioactivity of its soil"), and for the Rollercoaster and NTS herds to be relatively high. This appears to be the case (see Figure 3). Concentrations of plutonium in Rocky Flats cattle fall somewhere in the middle of the groups for all tissues (Figure 3). The authors conclude that "the data do suggest that the Rocky Flats cattle had a higher exposure to plutonium than the cattle from the Reno or Searchlight areas (background groups), and that this exposure was within the range of exposure of cattle on and around the NTS." The authors state that "the levels of both uranium and plutonium-239 found in the cattle are similar to those found in the general U.S. populations from fallout," and illustrate this fact for Pu in Figure 4 of their report.

I did a quick dose calculation for a person consuming meat from cattle grazing east of Rocky Flats. The ingestion dose factors I used were those selected by ChemRisk (1993) for Phase I. The committed effective dose equivalent from consuming 1/2 pound of meat per day containing the maximum measured concentrations of ^{239}Pu and ^{241}Am was computed to be 0.02–0.03 mrem following 1-yr's ingestion. The calculation based on the geometric average measured concentrations was a factor of 10 less (0.002–0.003 mrem). Over 90% of the calculated dose is contributed by americium, and less than 10% from plutonium. Some fraction of this total dose is actually due to globally dispersed fallout and not Rocky Flats. There were no data reported for uranium in the muscle tissue, but relative concentrations for other tissues suggests that U would contribute a higher dose than Pu or Am. This quick calculation supports the finding in Phase I that radiation doses from Rocky Flats-released materials via ingestion pathways would have been very small.

LITERATURE CITED

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Version 3, 5/13/94

Responses to Concerns Raised by Environmental Information Network and Concerned Citizens to the Rocky Flats Dose Reconstruction Project

Compiled by *Radiological Assessments Corporation*

The following concerns have been raised by Environmental Information Network (EIN) and other concerned citizens to the Rocky Flats Dose Reconstruction Project. These concerns have been compiled by Radiological Assessments Corporation (RAC) from transcripts of past Health Advisory Panel meetings, letters sent to the Colorado Department of Health (CDH), and other sources of documentation produced by the public.

For every concern raised, RAC has indicated what action is planned to address the issue, and the current status. Although a number of the concerns raised were addressed to Phase I of the study, for completeness they are noted here, as they may have repercussions for Phase II of the study.

-Concerns of Ms Paula Elofson-Gardine (Environmental Information Network)

1. Inadequate and inappropriate document research methodologies have been utilized in Phase I by ChemRisk. Reliance on keyword searches and scanning abstracts rather than manual document search and review has resulted in important information being missed.
   Source: EIN newsletter Fall 1993.
   Action: Systematic search of classified records being conducted as part of Phases II.
   Status: **Resolved.** All classified documents in Building 881 archives vaults have been systematically searched. The search for classified records will now be directed to other areas on site. A thorough search of documents (unclassified) housed at the Federal Records Center is now being conducted based on records' receipts at RFP.

2. Sampling location VG-4 was identified as Ralston School in the original Hammond paper from 1958, but did not specify the location of Ralston School. In 1980, Carl Johnson summarized the data from previous studies including Hammond's, and assumed that the location of Ralston School was at Lookout Mountain. However, in reviewing the actual sampling location information it was determined that the school was located 5 miles SSE of RFP on Hwy. 72, 3 miles NW of Arvada. Carl Johnson had mistakenly assumed that Hammond's paper referred to another Ralston School located 15 miles SSW of RFP on Columbine Glen Road at Lookout Mountain.
   Source: Recurrent topic at earlier HAP meetings.
   Status: **Resolved.** Resolved by Kathleen Meyer/Paul Voillequé/Bini Abbott/Terrol Winsor. See HAP meeting 5/93 transcript. It is documented in the report

"Verification of the Ralston School Soil Sampling Location Following the 1957 Fire", RAC Team, July 1993, which was included in the September 1993 Briefing Book.
– *Paula then stated that people wanted to know where the entire AEC survey occurred (p. 476).*
– *All survey data applicable to the 1957 fire will be available in RAC's reports.*

3. The highly variable meteorological conditions around the RFP and the unique topography of the area are not adequately accounted for when determining the deposition of atmospheric releases.
Source: HAP meeting 9/93 transcript, p.59, p.148, p.150.
Action: RAC is working together with Frank Gifford to identify and test other meteorological models for the region.
Status: In progress.

4. Impact of morning dews on deposition during the 1957 and 1969 fires. ChemRisk assumed there was no precipitation scavenging or wet deposition during these incidents.
Source: HAP meeting 9/93 transcript, p.60.
Action: Frank Gifford.
Status: As part of RAC's efforts to reconstruct these two events the most accurate weather information is being compiled. From this it may be possible to determine if the dew point was likely to have been reached at RFP on these occasions.

5. The limited sampling data do not allow the fraction of material that has been blown beyond the 10 mile perimeter to be quantified. The source term will therefore be significantly underestimated because the sampling data are used by ChemRisk to quantify it. EIN claims that the consistent history of sustained frontal down draft wind storms (Chinook winds) have contributed to a massive redistribution of this contamination away from the plant toward the Denver Metro area. Paula Elofson-Gardine questions if there is even 1% deposition of the total release from the facility within a 10 mile radius.
Source: HAP meeting 9/93 transcript, p.60, p.162.
Action: Paul Voillequé has made some initial scoping calculations for deposition in the vicinity of RFP. These were presented at the December 1993 HAP meeting. He showed that for a release of 0.3μm diameter particles approximately 7–8% would be deposited within a 10 km radius of the plant, and for a release of 3μm diameter particles approximately 30–40% would be deposited within a 10 km radius of the plant.
Status: More detailed calculations that take into account distribution of particle sizes released are planned.

6. Unease with the procedure that is used to determine the average concentration of routine contaminant releases. There is concern that the averaging techniques that have been used by the plant and ChemRisk, tend to decrease the calculated release concentrations. Paula Elofson-Gardine cites Dr. Briggs and Dr. Martell being aware

of specific site-specific issues where the data are minimized by the averaging techniques of the facilities. They are concerned that the averages mask the extreme values, and that there is over-correction for the background at the RFP. EIN draw attention to Appendix I of the ChemRisk Task 5 Report (dated March 1994) in which the annual average concentrations of radionuclide concentrations in drinking water are presented in table format. EIN request that this information be presented in graphical form with the monthly values instead of the annual values.
Source: HAP meeting 9/93 transcript, p.100-101. EIN memorandum dated March 14, 1994 "EIN comments regarding – Briefing Book 15: Concerns raised by members of the public to the Rocky Flats Dose Reconstruction Project (RFDRP)."
Action: Sue Rope.
Status: Background concentrations are to be determined as part of Task 4, and this may shed some light on this issue. Furthermore, we will not be only using the average values.

7. Monitoring deficiencies: air sampling equipment does not collect all the particulate sizes. This issue has been raised repeatedly.
Source: An Open Response to CDH Newsletter "The Update" – EIN; HAP meeting 5/93, 9/93 transcripts, EIN newsletter Fall 1993.
Action: Paul Voillequé.
Status: Paul Voillequé made a presentation on this issue at the Nov. '93 HAP meeting. He also sent a letter to Gale Biggs on 1/4/94 explaining that numerous studies indicate that airborne plutonium is associated with airborne dust particles having a broad spectrum of aerodynamic diameters.
This topic is being evaluated further, and has been identified for a Special Issues Topic Paper within the study.

8. The possibility that Pu becomes attached to pine pollen and other organic particulates, and is transported large distances, or is continually resuspended exposing and reexposing people during the temperature inversions that occur in the region. Dr. Nichols is the contact for this work.
Source: HAP meeting 9/93 transcript, p.171.
Action: Paul Voillequé.
Status: This is very closely related to the previous point (7) and Paul Voillequé is addressing this issue under point 7.

9. Failure to talk with the right population of people from within the plant to determine exactly how things were done. Paula Elofson-Cardine states that workers may have faked numbers entered on the records, bad managers were told to falsify records, in some cases no records were kept, and that there was liberal use of fudge factors when producing documents.
Source: HAP meeting 5/93, 9/93 (p.163) transcripts

Action: RAC is following up on all leads provided by concerned citizens. Terrol Winsor interviewed Paula Elofson-Cardine and Susan Hurst on February 17, 1994 following the CESC meeting to obtain more specific information.
Status: Paula Elofson-Cardine and Susan Hurst provided the names and telephone numbers of two former Rocky Flats employees who could provide further information on this subject. RAC is currently documenting a policy for interviews which will be reviewed by interested parties for approval. After approval the interview process will be resumed.

10. Paula Elofson-Cardine claims that there are records from engineers that show contaminated groundwater has been measured offsite. EIN state that Mr. Tom Courtney indicated to the HAP that Dames and Moore had previously done studies on this, and others are in possession of similar reports.
Source: HAP meeting 9/93 transcript; EIN memorandum dated March 14, 1994 "EIN comments regarding – Briefing Book 15: Concerns raised by members of the public to the Rocky Flats Dose Reconstruction Project (RFDRP)."
Action: Terrol Winsor.
Status: Terrol Winsor interviewed Paula Elofson-Cardine and Susan Hurst on February 17, 1994 following the CESC meeting to obtain more specific information. He is following up these leads.

11. A member of EIN, considers that the PR during Phase I has not been at all satisfactory. Specific issues raised by citizens should be properly addressed in the study, and not dismissed out of hand without an explanation.
Source: HAP meeting 5/93 transcript
Action: RAC agrees that citizens' concerns should be addressed as soon as possible. RAC is endeavoring to identify and address all the issues raised by citizens. RAC does not expect to follow up on all suggestions, but in such cases RAC will explain clearly the reasons for not pursuing an issue further.
Status: Bill Kemper has provided a list of questions to RAC via CDH, which RAC has responded to. We have developed this list of concerns specifically to address this issue. Terrol Winsor is supervising a database of RFP contacts to track our progress in this area.

12. The Front Range Reading Room is not sufficiently accessible to members of the public. A local library in the vicinity of the plant would be preferable. Given the size of the ChemRisk Task reports the time for public response has been too short. At a later HAP meeting Paula Elofson-Cardine stated that the lack of response [from ChemRisk/CDH to the public's comments] on the Task 3 and 4 reports discouraged many people from commenting further because they felt it wouldn't go anywhere; that the promised changes wouldn't be made.
Source: HAP meeting 5/93 transcript, HAP meeting 11/93 transcript, p. 42.
Action: RAC is allowing a longer time period for public response to draft Phase II Task reports. In the case of the draft Phase II Task 2 report which has been available

since December 1993, a second extended deadline for comments has been set at six weeks following the release of the Summer 1994 RFP Newsletter. RAC is committed to responding to all comments, and if a person wishes to comment on any report that RAC issues but is unable to do so within the allotted time period they are urged to contact us immediately so that a mutually beneficial solution can be arrived at if at all feasible.

It should be noted that ChemRisk did provide written responses to EIN's comments. However, EIN did not consider that these were satisfactory; "ChemRisk failed to identify and adequately respond to many specific and detailed comments/questions that required more follow-up."

It is our understanding that a decision has been made to append all comments and responses received from the public and interested parties to the ChemRisk Phase I Reports for Tasks 5, 6, 7 and 8 when they are reissued. There are no plans to reissue the ChemRisk Phase I Tasks 3&4 Report.

In addition to the U.S. Department of Energy Rocky Flats Public Reading Room, material about the Dose Reconstruction Project is also accessible to members of the public at three other reading rooms. Details of these are provided below:

Front Range Community College Library
3645 W. 122th Avenue
Westminster, CO 80030.
(303) 469-4435
Hours of Operation:
10:30 a.m. – 6:30 p.m. Monday and Tuesday
10:30 a.m. – 4:00 p.m. Wednesday
8:00 a.m. – 4:00 p.m. Thursday and Friday

The Colorado Department of Health
Information Center, Bldg. A-1
4300 Cherry Creek Drive South
Denver, CO 80222-1530
(303) 692-2035
1-800-866-7689
Hours of Operation:
8:00 a.m. – 5:00 p.m. Monday – Friday

Citizens Advisory Board
9035 Wadsworth Parkway, Suite 2250
Westminster, CO 80021
Hours of Operation:
8:30 a.m. – 5:00 p.m. Monday – Friday

Norlin Library
University of Colorado at Boulder
Boulder, CO

(303) 492 7511
Hours of Operation:
8:00 a.m. – 5:00 p.m. Monday – Friday
Status: Complete.

13. Concern that the 1957 Fire receives all the attention in the dose reconstruction and that the 1969 fire is forgotten. According to Paula Elofson-Gardine in many people's eyes, it's an element of greater importance than the '57 fire.
Source: HAP meeting 11/93 transcript, p.68.
Action: RAC will investigate the 1957 fire as a first priority, and will investigate the 1969 fire afterwards.
Status: Paul Voillequé and other members of the RAC Team are currently searching both on and offsite for original documentation related to the '57 fire and/or the '69 fire. However, calculational analyses will be carried out for the '57 fire first.

14. Concern that not all the materials of concern have been adequately addressed. Some have fallen through the cracks, in particular, dioxins and americium (propylene ethylene oxide was also mentioned p.75 of transcript). See also point c. below.
Source: HAP meeting 11/93 transcript, p.69.
Action: Include as an agenda item at the March 1994 Health Advisory Panel meeting.
Status: A discussion of dioxins and americium in the context of the Rocky Flats Dose Reconstruction Project was included on the agenda at the March 1994 HAP meeting. Following this a document relating to the dioxin issue is being prepared for distribution and review. Americium was identified as a radionuclide of concern in Phase I and calculations have been made for it. During the HAP meeting, the basic information about americium was reviewed, its relative importance with regard to Pu-239/240 in the Phase I calculations explained, and the major sources of modeling uncertainties identified. Paula Elofson-Gardine has also carried her concern about americium to the CESC where it is identified as an agenda item. No funding is currently available for additional sampling and analyses.

Concerns of Mr. Jim Stone
(Jim Stone states that he started in 1952 with the original design at Rocky Flats as a subcontractor with Sterns. He started full time with Rockwell in 1980, with the idea that they were going to completely renovate Rocky Flats.)

15. Appreciation of the lack of quality control over the years at RFP in regards to records and monitoring. It is naive to rely on monitoring records, even original monitoring records. There was a lack of quality assurance and maintenance of the buildings (leakage of the buildings, broken sewer lines, corroded process lines). EIN have suggested that a roster of employees that have worked certain processes and lines over the years should be obtained for direct and uncensored interviews.
Source: HAP meeting 9/93 transcript, p.131 onwards.

Action: This item is closely related to point 9 and is treated under the response to point 9. In general, in dose reconstruction we address data quality issues by attempting to quantify bias and uncertainty in the measurements. We do not generally dismiss any dataset without careful examination. This is because there are only a limited number of sources of information about past events, and we try to use as many of them as possible.
Status: See item 9 above.

Concerns Regarding Phase I Work.

16. The ChemRisk Phase I Task 3 & 4 report was commented on in detail by EIN, however, EIN were concerned that many of the issues they raised were not resolved and a revised Task 3 & 4 report had not been issued. At the Public Involvement Subcommittee meeting held on February 8, 1994, CDH stated that the ChemRisk Task 3 & 4 report for Phase I would not be revised and re-issued.
Although the Task 3 & 4 report is not a direct concern to *RAC*, the concerns raised by EIN to that report are of interest as they do relate to the subsequent phases of the study.

a. A number of individuals have been recommended by EIN to be contacted about the project.
Source: letter to Normie Morin
Status: Terrol Winsor interviewed Paula Elofson-Gardine and Susan Hurst on February 17, 1994 following the CESC meeting to obtain more specific information. They provided Terrol Winsor with the telephone numbers of all the individuals except for one, whose number is available in the telephone directory.

b. Consideration of interviews conducted by Dr. Johnson to establish dust loading in the HEPA filters that were blown out by the explosion with the remaining materials burned and released from the fire.
Source: letter to Normie Morin
Status: Terrol Winsor interviewed Paula Elofson-Gardine and Susan Hurst on February 17, 1994 following the CESC meeting to obtain more specific information. They stated that many supporting interviews are contained in Dr. Johnson's records in the Western Historical Archives at Colorado University . RAC intends to review the information contained in these interviews when reassessing the impact of the fire.

c. The following are not included as materials of concern in the dose reconstruction: ethylene oxide, propylene oxide, nitric acid, PCBs, dioxin and furan releases, asbestos.
Source: letter to Normie Morin
Status: A discussion of dioxins and americium was included on the agenda for the March 1994 Health Advisory Panel meeting (see point 14 above).

d. TLD records may be indicative of problem areas or significant events that were not reported. Such data should be sought and reviewed in the project.
Source: letter to Normie Morin
Action: TLD data are not directly applicable to the dose reconstruction because the measurements refer to locations onsite and within buildings. There may be a circumstance where these data could be useful to verify the time of an event. We would only use it in the absence of other more direct information, such as incident/accident reports. However, we do agree that such data may be useful for the worker study and we have contacted CDH (Amy Johnson) about this. She states that these records are being reviewed in that study.
Status: Complete.

e. The incinerator that included radionuclide residues and depleted uranium chips being bulldozed over the 881 hillside into the Woman Creek drainage should be evaluated for contaminants being washed downstream by seasonal torrential rains.
Source: letter to Normie Morin
Status: Terrel Winsor interviewed Paula Elofson-Gardine and Susan Hurst on February 17, 1994 following the CESC meeting. They consider this topic should have been investigated further. Very little information is provided in the ChemRisk Task 3 & 4 report for Phase I (page 195). EIN state that further incinerator concerns and information are available from workers that have operated some of these incinerators, who maintain that large releases have occurred from these operations. We hope to be able to follow up on this as soon as a mutually acceptable policy on interviews is established.
Recent document review at Rocky Flats by RAC team members has identified records referring to a special survey of the former incinerator on the West Access Road that include flow rate measurements for the exhaust during operations. There is also an indication that activity concentration measurements were made in the stack for June, July and August of 1958. Copies of these records have been requested and will be examined more closely. The incinerator was discussed further during the discussion on dioxins at the March 1994 Health Advisory Panel meeting and is being documented.

f. 903 Pad. According to EIN, Martin Hestmark who works for EPA and is the Federal Facility Compliance representative has referred to core sampling having been done at the 903 Pad. They feel this data should be obtained and evaluated.
Source: letter to Normie Morin
Action: Terrel Winsor (to interview), Marilyn Case(to follow up)
Status: Paula Elofson-Gardine and Susan Hurst have provided Terrel Winsor with Martin Hestmark's telephone number to follow up on this issue.

g. 1969 Fire. EIN claim that they can provide corroborative witnesses that can verify that barrels containing ash from the fire are still at the plant site and can be sampled and analyzed.

Source: letter to Normie Morin
Status: Paula Elofson-Gardine and Susan Hurst informed Terrol Winsor that they can direct RAC to an individual who was involved in the repackaging of the ash.
Action: Terrol to obtain further information.

Version 3, 6/4/94

Responses to Questions from William Kemper Concerning the Rocky Flats Dose Reconstruction Project.

Compiled by *Radiological Assessments Corporation*

The following questions from William Kemper were submitted to the Health Advisory Panel and passed on to Radiological Assessments Corporation (RAC) via Normie Morin of the Colorado Department of Health (CDH), during the December 1993 Health Advisory Panel meeting. The question numbers in the list refer to the original numbering in William Kemper's handwritten list. However, the questions have been reordered according to the different topic areas that they address. At RAC's request William Kemper expanded upon a number of the questions to clarify the issues of concern in a letter dated February 10, 1994. These changes have been incorporated into the list below.

Questions to CDH

3. Can CDH make a listing of number of cases (not deaths) of childhood leukemia and thyroid cancer per 100,000 population in Denver, Jefferson, Adams, and Boulder counties and the cities of Evergreen, Golden, Lakewood, Wheatridge, Westminster, North Glen, Arvada, Broomfield, Louisville, Lafayette, Loveland, Greeley, Fort Collins by year 1940 to present?

- CDH response distributed at the March 1994 Health Advisory Panel meeting.

Status: ❒ Complete.

4. The following question arises perhaps too late, but would the money being spent on the two HAP contractor studies - Chem Risk and RAC be better spent on other aspects of cleanup that affect the future rather than look back on the past?

- CDH response distributed at the March 1994 Health Advisory Panel meeting.

Status: ❒ Complete.

Technical Questions

1. How does the toxicity of ^{235}U compare with that of ^{239}Pu? Is it the same on a per Ci basis? If so, since the $^{1}/_{2}$ life ^{239}Pu is 2.4 x 10^{4} yr and ^{235}U is 7 x 10^{8} yr, on a per gram basis ^{239}Pu it would be about 3 x 10^{4} times as toxic.

Are ^{235}U and ^{239}Pu absorbed to the same extent by the body, once ingested? Are their biological residence times in the body the same? [Part A]
The Task 3 & 4 reports suggest ^{235}U was used for weapons almost to the extent of ^{239}Pu up until 1962 (See p. 68 Task 3 & 4). Were all bomb triggers fabricated at RFP after 1962 Pu? Was any ^{235}U in path of '57 or '69 fires? Is any in ductworks or filters? Apparently some were in the oils on Pad 903 (p.68 Task 3 & 4). Is there any in sediment of Standley Lake or Great Western Reservoir? If the answer to the 2nd question is yes, and results of analyses for Pu that we are given are Ci of both ^{235}U and ^{239}Pu, I suppose remainder of above questions are not really needed.
The question on the composition of the triggers after 1962 may be classified, but if the triggers after 1962 were not 100% Pu, there must have been continued use of U after 1962. [Part B]
Action: Paul Voillequé.

- Part A: There are several comparisons that can be made. First, consider the most "insoluble" aerosol forms, which are termed Class Y compounds by the International Commission on Radiological Protection (ICRP). Such aerosols have deep lung clearance times that are on the order of years. The dose conversion factor (DCF) for ^{235}U is less than half that for ^{239}Pu, 1.2 x 10^5 versus 3.1 x 10^5 mrem per μCi inhaled. Both values assume an aerosol with an activity median aerodynamic diameter of 1μm. For somewhat more soluble compounds, those termed class W (for clearance times of weeks), and the same aerosol size distribution, the DCF for ^{235}U is 6.7 x 10^3 mrem per μCi inhaled and that for ^{239}Pu is 4.4 x 10^5 mrem per μCi inhaled. Some uranium but no plutonium, compounds are considered Class D (for days), the most rapidly cleared category. For the same particle size distribution, the DCF for Class D ^{235}U is even lower, 2.5 x 10^3 mrem per μCi inhaled.

For ingested activity, uptake from the gut is typically greater for uranium compounds than for those of plutonium. The highest adult uptake fraction for uranium is taken to be 0.05, while that for unknown forms of plutonium in the environment is 0.001. The DCF for ^{235}U is 2.5 x 10^2 that for ^{239}Pu is 3.6 x 10^3 mrem per μCi ingested.

All of the above comparisons of dose factors are for adults because age-dependent values are not yet available for uranium. The DCFs for ^{235}U were taked from ICRP Publication 30, Limits for Intakes of Radionuclides by Workers (1979), while those for ^{239}Pu were taken from ICRP Publication 56, Age-Dependent Doses to Members of the Public from Intake of Radionuclides: Part 1 (1989). A future publication updating and

expanding the models for uranium may well change the DCFs for U. The DCFs for ingestion reflect uptake from the gut, distribution in body tissues, and retention in those tissues. While, as noted, uptake of uranium is generally higher, smaller fractions are fixed in tissues, and retention times are shorter than those for plutonium. Gut uptake for material cleared from the respiratory tract, its subsequent distribution in tissues, and tissues-specific retention times are also modeled in the derivation of DCFs for inhalation that were listed above.

Part B: To address the overall concern first, there was continued usage of uranium after 1962. This is shown in the effluent data (see, for example, Table B-7 of the Task 5 report). Most of the uranium released was ^{238}U. The DCFs for ^{238}U are about 10% greater than those for ^{235}U. It should be further noted that the DCFs for all the uranium isotopes of interest (^{233}U,^{234}U,^{235}U,^{236}U, and ^{238}U) are all within about 10% of the value for ^{235}U. The DCFs for the alpha-emitting isotopes of plutonium are also tightly grouped and the values for ^{239}Pu given above are representative of Rocky Flats plutonium.

I do not have the answer to the bomb trigger question, but it is clear that uranium releases continued beyond 1962.

To the best of my knowledge, there was no uranium involved in the fires in 1957 or 1969; both occurred in plutonium facilities. There is no doubt some uranium in ductwork and in filters in buildings that processed uranium, although I have not seen any quantitative estimates.

Because uranium has been released routinely over many years of operation, one could expect some increase in the uranium concentrations at downwind locations. However, whether the uranium is observable in sediment cores depends upon both uranium chemistry and whether any deposit increase can be distinguished from the background uranium activity already present. A further assessment will be made when all the core data have been compiled.

Status: ❒ Complete.

2. What is the solubility of the oxides of Pu (which oxide is most stable in the sediment?) in water in the temperature range 32˚– 85˚F and pH 4.5-8? What is max (85˚F, 4.5pH)? What other factors can affect solubility, Ca content?

Action: Helen Grogan

- There are many factors that will determine the concentration of plutonium in water. Among these is its solubility under the particular

chemical conditions of the groundwater, including, for example, the pH, redox potential, salinity, temperature, carbonate concentration and the presence of complexing ligands. Pu may subsequently be removed from solution by other mechanisms such as sorption onto solid surfaces or by colloid formation or sorption onto pre-existing colloids.

Allard (1982) reports that natural waters contain a number of complexing agents such as OH^- (pH 4-10), HCO_3^- —CO_3^{2-} (0.3-8mM), $H_2PO_4^{2-}$ —PO_4^{3-} (<0.001 mM), F^- (0.003-0.2 mM), SO_4^{2-} (0.01-1.0 mM) and Cl^- (0.05-5 mM) (the expected concentration ranges for non-saline waters are given in parentheses). Moreover, most waters contain organic complexing agents of natural origin (humic acids, fulvic acids, etc.) and possibly also of human origin (e.g. various carboxylic acids). All these complexing agents have to be considered when assessing plutonium speciation and solubility. Although data are scarce organic matter such as humic and fulvic acids can have an important effect on speciation and complex formation for actinides such as Pu.

Considering inorganic systems only, the behavior of plutonium in environmental waters is almost entirely dominated by hydroxide and carbonate complexation. Under oxidizing conditions the solubility limiting species is PuO_2(s), with $Pu(OH)_4$ as the dominating species in solution at pH 6–9. The solubility of $Pu(OH)_4$ over this pH range is ~10–10.5 M (K.Andersson, 1992). At pH below 5-6 the pentavalent PuO_2 would be the major species down to pH 4 where Pu^{3+} would dominate (Allard, 1982).

Under reducing conditions the solubility limiting species would be $Pu_2(CO_3)_3$(s) below pH 7–8 and PuO_2 (s) at high pH. Trivalent species would dominate in the intermediate pH range 6 to ~7.3, then $PuCO_3^+$ to pH ~7.8, and above this pH $Pu(OH)_4$ (K.Andersson, 1992). Thus, plutonium could in fact exhibit any of the oxidation states III, IV or V in solution under environmental conditions. This does not consider the effects of organics, which may possibly significantly affect the speciation at high concentrations and low pH. The solubility of all the actinides, except possibly of plutonium under oxic conditions, is enhanced by the presence of carbonate, often by several orders of magnitude. The above calculations are at a temperature of 77°F (25°C). A temperature shift to 167°F (75°C) tends to decrease solubility under reducing conditions at low pH values and yields a solubility increase for all other conditions.

Thus, under oxidizing conditions the oxidation states Pu(IV) (or Pu(V) would dominate at environmental pH; under reducing conditions the oxidation states Pu(III) (lower pH values) and (IV) are expected to dominate.

According to D.M. Nelson, R.P. Larson and W.R. Penrose (1983), the reduced Pu(III,IV) prevails over the oxidized ones (Pu(V,VI)) in waters with a high dissolved organic carbon (more than a few mg/L). Low particle densities also favor the reduced forms. Adsorption to natural particles is mainly by these reduced forms. The solubility of Pu is higher in waters with higher colloidal organic carbon content.

Experiments on the oxidation state of Pu in terrestrial soils from the UK have shown that Pu(III) or Pu(IV) is predominant, and Pu(V) and Pu(VI) were undetectable. This was attributed to the reducing ability of the organic component of the soil. The organic material held most (50-70%) of the plutonium whilst the remainder was associated with the sesqueoxides and residual fractions (Livens, F.R., Baxter, M.S. and Allen, S.E., 1985.).

The mechanism for the sorption of hydrolyzed actinides on solid surfaces can be considered as a physical adsorption process, relatively unaffected by the ionic strength, nuclide concentration (below the solubility product) and ion exchange capacity of the solid, and also without any pronounced temperature dependence.

It is clear that determining plutonium speciation and solubility in the natural environment is a complex issue that requires knowledge of a large number of different variables.

Status: ❒ Complete.

7. I realize this is unlikely, but is there a possibility of making PuF_6 in the refining of Pu by fluoridation? What I am concerned about here is that PuF_6 is, I presume, a gas or liquid with high vapor pressure like UF_6 and might escape.

Action: Paul Voillequé/Neils Schonbeck

- There is no evidence in process descriptions that PuF_6 is ever produced at Rocky Flats. The plutonium undergoing fluorination is in the +4 valence state. Unwanted production of the PuF_3 is avoided by process design. PuF_6 has a molecular weight of 355.99 and is described as a reddish brown crystalline substance with a melting point of 50.75°C and a boiling point of 62.3°C.

Status: Complete.

23. How does water in a Pu fire, or in a Pu storage area, increase the criticality risk? It is stated that firemen were cautioned not to use water to extinguish the Pu fire.

Action: Neils Schonbeck

- Water is a neutron moderator and reflector and may reduce the amount of fissile material required to achieve a criticality, other geometrical factors being equal. Water may also transport fissile material (as it flows by gravity)

to a confined space. Accumulation of fissile material in such a space could result in a criticality.
Status: ❒ Complete.

29. It might be worth investigating the particle size of PuO_2 from burning Pu. Is there a most likely particle size? If so, knowledge of what it is would help in fallout studies.
Action: Paul Voillequé
Status: ❒ This issue will be addressed in RAC's reconstruction of the 1957 fire.

5. How do you assess the tritium hazard? What are the published limits or standards for tritium in drinking water? In air? I realize tritium has a short half life and residence time in the body, but I'd like to see some evaluation of tritium hazards. Perhaps this is somewhere in reports - If so, where?
Action: Bob Meyer
Status: ❒ Complete. See response to question 6.

6. In the proposed thermal stabilization of Pu, what if, as in the past, the Pu is contaminated with tritium? Enough to give a hazardous emission of tritiated water?
Action: Bob Meyer
Response to questions 5 and 6:

- For several reasons, tritium is one of the least hazardous of the radionuclides per unit activity, with a relatively high allowable human intake. Tritium distributes uniformly in body fluids, not concentrating in any tissue, and the tritium decay produces a very low energy beta particle. For comparison, plutonium is one of the most hazardous radionuclides, with a relatively low allowable intake. Plutonium selectively deposits in small volumes in the body, and emits an energetic alpha particle. Radiation dose and risk are strongly related to these factors, and the annual intake limit for tritium in water vapor is roughly 13 million times higher than that for plutonium.

From Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration, and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, 1988:

Tritium in water vapor, annual limit for inhalation intake, 8×10^{4} μCi;

Plutonium 239, annual limit for inhalation intake: 6×10^{-3} μCi.

According to the records *RAC* has reviewed, Rocky Flats acquired additional instrumentation, and modified their receipt inspection procedures, after a previous incident involving tritium-contaminated weapons material caused offsite contamination discovered by the Colorado Department of Health.

Tritium should not be processed at the RFP; these modifications should have reduced the likelihood of tritium being released if significant quantities are inadvertently received again. The relatively low hazard of tritium per unit activity, combined with these specific procedures to prevent inadvertent processing, reduce the potential hazard of tritium at Rocky Flats to very low levels, in our opinion.
Status: ❒ Complete.

11. It has been stated (EIN Newsletter Fall '93) that the Am concentration in bovine tissue of cattle grazing near RFP was $^1/_4$ to $^1/_2$ that of Pu239. Considering that the ratio of Am to Pu in weapons material is so low, how is it that Am is this high? Is the concentration in grams or Ci? Is Am retained more in tissue than Pu? The same report gives .77 pCi/g of U238 in the soil. This seems extremely high considering that U238 is not very active. Please comment.
Action: Sue Rope. Response distributed at the March 1994 Health Advisory Panel meeting.
Status: ❒ Complete.

12. How is byproduct Am stored at RFP?
Action: Helen Grogan

- Byproduct americium is not stored at RFP. It is purified onsite and then shipped to Oak Ridge where it is sold to a private industry. The major proportion of the americium is used in the production of smoke detectors.

Status: ❒ Complete.

20. Tasks 3 & 4 Report, p. 70 Fig 3–12 shows Am residues after '67 prepared for burial. Where was the Am buried?
Action: Helen Grogan/Paul Voillequé

- Significant quantities of solid waste contaminated with plutonium and americium isotopes were shipped to the Idaho National Engineering Laboratory (INEL) for burial. Approximately 48,000 curies of ^{241}Am were buried at the INEL. Burial of Rocky Flats transuranic wastes was halted in 1970. The ^{241}Am content of wastes stored at the INEL exceeds 130,000 Ci.

Status: ❒ Complete.

15. Do we have a summary of the Church Litigation claims and assertions? These are not in Task 3 & 4 report p. 30 and 31. Was the Church claim in reference to the '57 fire?
Action: Kathleen Meyer

- *RAC* has access to documents gathered by both the plaintiffs and the defendants in the Church litigation, and is aware of the major claims

and assertions made by the plaintiffs. In May 1975, a lawsuit was filed against Rockwell International Corporation, Dow Chemical Company, and the United States of America by the Church (McKay) plaintiffs and Great Western Venture partnership. The plaintiffs owned approximately 2,000 acres of land to the west, south and east of the Rocky Flats Plant (RFP). They contended that their lands had been damaged by releases of plutonium and other radioactive materials from the RFP. As a result of this litigation, several sources and collections of documents were developed by both the plaintiffs and defendants.

At the RFP, a legal file was established with a large variety of documents related to environmental issues gathered. The resulting Legal/Environmental File covered the time period 1952 to about 1978, and contains over 20,000 documents. This latter file was used extensively by ChemRisk in completing Phase I of the project.

For the plaintiffs, over 500 pages of pre-trial statements for the Church-McKay Litigation were prepared (Fairfield and Woods 1978). These include:

→Volume 1 – General Introduction, purpose of the site, types and quantities of materials used, introduction to negligence, and considerations in selecting the Rocky Flats site;
→Volume II – Waste Management; description of the types, quantities and handling of radioactive waste with a description of the outside storage areas and pads, trenches and ponds.
→Volume III – Fires, Monitoring and Disclosure highlighting the 1957 and 1969 fires; and
→Volume IV – List of Exhibits on topics such as the history of RFP, hazardous materials, site selection, waste management, ventilation systems, soil contamination and environmental monitoring.

The pre-trial statements have an extensive section on the 1957 fire, the 1969 fire and other fires and events onsite. *RAC* has copies of the complete set of the plaintiffs statements, and have used them, especially the exhibit list, in tracking down original source documents that are relevant to the project. In addition, we have accessed the Legal/Environmental database onsite to ensure that we are knowledgeable about all aspects of this litigation.

References

Fairfield and Woods. The Pre-Trial Statements of the Plaintiffs. U.S. District Court for the District of Colorado. 1978.

Status: ❒ Complete.

16. I have been told Harvey Nichols has some information that is of consequence, but is not recorded.
Action: Paul Voillequé
Status: ❒ In progress.

21. Are ponds B and solar ponds lined with plastic?
Action: Kathleen Meyer

- The solar evaporation ponds onsite were initially asphalt-lined, while the holding ponds (A, B and C series) were unlined. The holding ponds or on-channel reservoirs were constructed during the 1950s to the 1970s as dry gullies with earthen dams where liquids would evaporate or seep into the ground. Through the early 1970s, there were three ponds on Walnut Creek (A series), four ponds in sequence on South Walnut Creek (B series), and Pond C-1 on Woman Creek. Additional ponds were constructed on all three creeks in the mid-1970s and 1980s, and their overall flow patterns were changed.
  The first solar "water-tight evaporation pond" was put into service on August 31, 1956 to store and evaporate low-level radioactive process water containing high concentrations of nitrates and treated acidic wastes (Farrell and Ryan 1957). It had a surface area of 3 acres and a working capacity of 15 acre-feet. Up to that time, half of the decontaminated liquids went to the B "holding pond" in which seepage and infiltration of liquids would occur. The asphalt evaporation pond was constructed to prevent seepage or infiltration of liquids with higher contaminant levels. The five solar evaporation ponds: 207A (3 acres), 207B series (north, center, south, 1 acre each). and 207C (1 acre) have been used from the late 1950s until 1986. Pond 207C stores low-level radioactive liquid process wastes prior to evaporation, treatment and solidification in Building 374. The resulting sludge and sediments from 207A and B were removed periodically and disposed at the Nevada Test Site.
  As technology improved through the 1960s and 1970s, the solar evaporation ponds were relined with various upgraded materials; however, leakage from the ponds into the soil and groundwater was detected. Interceptor trenches were installed in 1971 to collect and recycle groundwater contaminated by the ponds and to prevent natural seepage and pond leakage from entering North Walnut Creek. Only 207B north solar evaporation pond received contaminated water from interceptor system in 1992 (EG&G 1992).
  Further information on the uses of both the unlined earthen ponds, and the solar evaporation ponds in the processing of liquid waste at Rocky Flats can be found in the *RAC Progress Report for Task 4, Evaluation of Historical Environmental Data*, issued in December 1993. The processes for treating liquid wastes at the Rocky Flats Plant have been fairly simple, and have changed relatively little over the years. Buildings 774 and 374 are the primary waste processing facilities onsite for handling liquid process wastes. Building 774 was built in 1952 to support Building 771 by treating its radioactive aqueous waste. Normal effluents included radioactive and/or chemical-

contaminated liquids generated in several process areas, laboratories, laundries and decontamination areas. Effluents were collected at or near their points of origin, analyzed and categorized.

Liquid wastes meeting the drinking water standards were stored in the unlined earthen ponds (B ponds), while wastes meeting the radioactive contaminant standards for onsite storage, but not meeting the drinking water standards for the chemical contaminants were stored in the asphalt-lined solar evaporation ponds, or, after 1982, transferred to Building 374. Subsequently, the Building 374 waste was discharged to the solar evaporation ponds, or to the "B" series of holding ponds and finally to the Great Western Reservoir. Although an evaporator was installed and operated in 774 from 1965 to 1979 to treat the liquids that had accumulated in the solar evaporation ponds, its limited capacity never did eliminate the need for the ponds.

References

Farrell, L.C. and E.S. Ryan. Revisions to Portion of Unclassified Document NYO 7830 Pertaining to Rocky Flats Plant Waste Disposal Operations Based on Fiscal Year 1957 Data. Waste Disposal Co-ordination Group. The Dow Chemical Company. pp 127, 130, 131, 133, 134, 136, and 137. no date. but assume 1957. (EG&G 1600637)

Owen, J.B. and L.M. Steward. A Historical Summation of Environmental Incidents Affecting Soils at or Near the U.S. AEC Rocky Flats Plant. Environmental Inventory. Rocky Flats Division Dow Chemical USA. January 29, 1974. (EG&G 1601057)

Status: ❒ Complete.

22. What is Shell-Vitrea (1957 fire Supple. Report)?

Action: Helen Grogan

- Shell Vitrea is a straight–chain hydrocarbon mineral oil that is used as a lathe coolant when machining plutonium and uranium.

Status: ❒ Complete.

24. What are CWS filters?

Action: Helen Grogan

- These are Chemical Warfare Service (CWS) filters.

Status: ❒ Complete.

28. What is meant by "Th strikes" Task 2,3 report p. 125?

Action: Terrol Winsor

- This is actually referring to the ChemRisk Task 3/4 Report. ChemRisk writes that “Twice during 1964 to 1969, “thorium strikes” removed gamma–emitting Th–228 and U–233 metal. The strikes used natural thorium (Putzier, 1982)”. The specific reference is Putzier, E. A., The Past 30 Years at Rocky Flats Plant. November 1982.

In essence, the material of interest to RFP was U–233. The problem is that U–233 as produced in the reactor brings U–232 along with the product. U–232 has a 'short' half-life and has a chain of radioactive daughters. The decay chain products have short half-lives and many emit gamma radiation which adds to the radiation hazard of working with the desired U–233. The first daughter of U–232 is Th–228 (half-life of 1.91 years).

The thorium strike breaks the radioactive chain by using natural thorium to carry down the unwanted radioactive Th–228. This process lowers the radiation level in the U–233 mixture to a minimum until Th–228 grows back in.

Status: ❒ Complete.

Questions Relating to the '57 Fire and Other Accidents and Incidents

25. In the '57 fire was the last filter between outside atmosphere and the ductworks breached? I note Vandegrift Rep., in ref Q26, p60, he states "Outside we could see a large cloud of smoke coming from the stack of 71 Bldg. "Also Venable p. 64 par. 2., p. 66.

Action: Paul Voillequé

- Yes. The filters that caught fire and burned after the fire in Room 180 was initially extinguished were part of the final filtration system.

Status: ❒ Complete.

26. In the unclassified version of the Report on '57 fire released 2/24/93, p. 22 the weight of two lost pieces of SS material (presumably Pu) has been deleted - though their value is estimated as $120,000.

Action: Paul Voillequé

- The weights of bomb components is classified; that is the reason for the deletion. The masses are known and are considered in the overall accountability of plutonium for the fire. We have examined both the classified report of the fire and other documents related to material accountability during the cleanup.

Status: ❒ Complete.

17. At time of '57 fire, there was said to be 43Kg Pu in the room where the fire started. How much of this was recovered after the fire? See Q25 ref p.72, some amount deleted. Also p. 73, 74, 75.

Action: Paul Voillequé

- The answer to this question is also presently classified. It is our hope that information like this that is related to the analysis of potential releases from the fire will be released by DOE. Discussions between EG&G Rocky Flats and DOE-RF classification personnel and DOE-HQ personnel regarding such a release are underway.

Status: ❒ Complete.

27. In ref. of Q25, p. 77, "airborne activity collected during the night was dependent upon the radon daughter chain." Where does Ru or Ra daughters come from? I do not understand the next sentences. What type of detector was used in the analyses reported p-77 by Chapman that would detect Pu, which is an alpha emitter only. Alpha has short range and is difficult to detect with portable equipment. Note l. par. Pu detected offsite.
Action: Paul Voillequé

- Radon (Rn) is a gaseous element formed by the decay of radium (Ra). The principal isotope of interest is ^{222}Rn; it arises from the alpha decay of ^{226}Ra in the soil, which itself is a result of the decay of uranium. The radon diffuses out of the ground into the air. At night, particularly if there is a temperature inversion, the concentrations of radon gas can build up and can substantially interfere with analyses for airborne plutonium. This is a particular problem at Rocky Flats because of the relatively high concentrations of natural uranium in the soil. The ^{222}Rn decays to form alpha-emitting radioactive isotopes of polonium as well as beta-emitting radioisotopes. The alpha particles from ^{218}Po and ^{214}Po are very energetic and can be detected more easily than those from plutonium when air sample filter is counted. However, they have short half-lives, so recounting the filter (after allowing some time for decay of the radon daughters) permits a better estimate of the long-lived activity to be made. For routine air sampling filters, a decay period of several days is often used; however, under emergency conditions shorter decay periods are essential. The counts due to plutonium collected on the filter will not change as the filter is counted at several times after collection, while the counts due to radon daughter activity will continually decrease.

  Both scintillation and ionization detectors were used to measure alpha-emitters in the early days. For the reason you state, the short range of alpha particles, the detector cover must be very thin or the counting arrangement such that no cover is used. An example of the latter type is the gas flow proportional counter. By proper adjustment of the voltage, this detector can reliably count alpha emissions in the presence of beta and gamma emissions because the alpha energy absorption in the counter is so much greater. Thin foils have also been used to cover alpha scintillation detectors in laboratory and field instruments. They are fragile and subject to damage; pinhole light leaks can interfere with their operation.

I am not certain which type of instrument was used for the environmental air sampling filter counting measurements following the fire, but either of the types described could have been employed successfully.
Status: ❒ Complete.

14. Could we be furnished with all the measurements of radioactivity in air samples at times of '57 and '69 fires? See p.76, 77 of ref. of Q25 below.
Action: Sue Rope
Status: ❒ This will be included as part of Task 4 in Phase II.

19. What were the Sr & Cs levels in the soil? Can these be accounted for by world wide fallout? Or, are these an indication of criticality at RFP?
Action: Paul Voillequé

- I have made some calculations for a hypothetical criticality at the Rocky Flats Plant to determine the amount of ^{137}Cs that might be in the environment if such an event happened. I considered an event in which 1.45×10^{19} fissions occurred, which corresponds to an energy release equivalent to the explosion of 200 pounds of TNT. An event of this magnitude could not go undetected within the plant. Calculations indicate that radiation doses from gamma rays alone would have been more than 100 rads at a distance of 50 feet and considerably higher at closer distances. Depending on the circumstances imagined, fatalities could have resulted from a criticality of the assumed magnitude.
  The number of fissions specified above would have produced about 0.02 Ci of ^{137}Cs with perhaps as much as 1% of that released to the atmosphere. For a ground level release and confinement of the plume to a single wind direction sector, the NRC Reg. Guide 1.111 methodology predicts a deposition of 8 pCi/m^2 (or 0.3 Bq/m^2) at a distance of 2 km from the release point. If all the ^{137}Cs (0.02 Ci) were released, the predicted deposition would be about 30 Bq/m^2 at that distance. Cumulative global fallout ^{137}Cs deposition at 40°N latitude is estimated (UNSCEAR 1993) to be about 4500 Bq/m^2. Variations of 1% in the average fallout deposition among sites would exceed the largest projected deposition of ^{137}Cs from a criticality. Such variations are to be expected due to differences in precipitation and in contributions from fallout due to specific NTS shots. The cumulative ^{137}Cs deposition in the Denver area from the NTS was about 400 Bq/m^2.
  The relative amounts of ^{90}Sr produced by a criticality and in the soil from fallout are both about 60% of the corresponding values for ^{137}Cs. Thus, a specific analysis for that nuclide would have no better chance of success for identifying residuals from the hypothetical criticality.

Status: ❒ Complete.

10. Can the locations of DNA's air sampling stations be furnished? These are to indicate foreign bomb tests. Can the records be furnished for the period two weeks before and after the dates of the ’57 and ’69 fires?

Action: Paul Voillequé
Status: ❒ In progress. Paul has written to William Kemper (1/6/94) detailing his efforts to date.

13. What was the subsequent health history of firemen at '57, '69 fires, and of RFP employees in the area when the fire commenced? What of employees on '65 glove box incident? Were municipal fire fighters summoned on other occasions than the '57 and '69 fires? See ref. of Q26 Pringle p.68, 69.
Action: Terrol Winsor.

- Based on the events described above, and any relevant information that can be identified relating to them, we will attempt to recreate a number of exposure scenarios for evaluation. At this stage it is not clear how successful such an analysis will be.

Status: ❒ In progress.

8. I'd like to know more about the 5/1/81 haystack fire. Was the firemen's health subsequently OK?
Action: Terrol Winsor
Comment: EIN Newsletter Fall '93 contains an article on this.
Status: ❒ In progress.

18. I would like more evaluation of the '65 glove box drain fire and the '64 Pu, CCl_4 explosion.
Action: Kathleen Meyer

- Both accidents occurred in Building 776, involved plutonium and carbon tetrachloride, and resulted in personnel contamination and extensive contamination inside the buildings.
- On June 12, an explosion occurred in a drybox containing a degreasing operation in Building 776 when a burning chip can slipped into the carbon tetrachloride dip tank below as the operator was attempting to remove it(Owen 1964). The injured man left the area, and personnel who helped the injured man, security guards and medical personnel were not aware immediately that the injury involved contamination. Two outside contractors who were onsite at the time left the site before being surveyed for contamination. They and their vehicles were surveyed after being recalled to the site. In one case, the person's home was surveyed and found to be free of contamination. Onsite, contamination was found throughout the first floor of Building 776. No contamination was reported in Building 777 or the office area and second floor of Building 776 (Owen 1964). The explosion resulted in an extensive release of plutonium to the interior and some to the exterior, primarily in soil to the north of that building (Owen & Steward 1974). The majority of the affected soil was removed or covered with asphalt.

- The 1965 glove box drain flash fire that vented to room air and was spread throughout the buildings by the normal ventilation system, occurred during a maintenance operation on glove box 752 in Building 777. The maintenance people were attempting to dislodge an obstruction in the coolant line by mechanical force. They were aware that plutonium chips could be present in the "leg of the coolant line", and also that carbon tetrachloride had been used in trying to flush out the obstruction previously. Sparks had been noticed before the fire vented to the room. Evidence suggested that the 30 to 90 second fire resulted from contact between the plutonium in the line and the steel punch being used to dislodge the obstruction, aided by carbon tetrachloride present in the line from a previous flushing. The reaction of plutonium and a chlorinated solvent like carbon tetrachloride can be quite violent (Hammond et al. 1965). Contamination from the fire was spread throughout Building 776 and over approximately 25,000 square feet of Building 77. Descriptions of the accident and subsequent cleanup are available (Hammond et al. 1965; ChemRisk 1993). Although it was reported that more alpha activity was released from the 1965 glove box fire (1170 mCi) than from the 1969 fire (856 mCi) (US DOE 1980), only a portion of that escaped to the outside. It was estimated, based on air samples from the main exhaust ducts from this area taken after filtration, that approximately 170 mCi passed through the final filters as a result of this fire. About 10 to 15% of this air was re-circulated to the second floor of Building 776, and may have accounted for the air contamination on the second floor. For large-scale offsite exposures, this fire was not of the same magnitude as the 1957 or 1969 fire. However, consideration must be given to situations like the one that occurred after this accident where contractors carried contamination offsite.

  Although these accidents did result in offsite releases to air, and in the case of the 1964 fire, to contamination carried offsite on an individual, the release estimates are considerably less than those from the major events that we are investigating thoroughly in Phase II. The primary focus of these two events is personnel exposure, and will be important to consider in the current worker study being conducted by the Colorado Department of Health. Contamination control in both events was not adequate. In the June 1964 explosion, both onsite personnel and outside contractors who were onsite at the time did not realize immediately that contamination was involved. For the onsite exposure of workers, the 1965 glovebox fire was a major event involving a large number of people. Lack of proper communication resulted in the personnel not being aware of the need for respiratory protection until

as much as ten minutes after the incident (Kittinger and Johnson 1965).

For dose reconstruction, these two onsite accidents represent incidents that may not be key events in terms of plutonium releases to the atmosphere or to surface water. However, we will consider the situation in which outside contractors may have carried contamination offsite. (Please see our response to Question #13). Furthermore, from the perspective of workers, these accidents may have resulted in considerable exposures to some personnel. *RAC* will alert those involved in the CDH worker study about major accidents involving personnel exposure if we find such information during our document reviews. For the Phase II work, *RAC* will continue to investigate all relevant documentation and talk to those who have knowledge about incidents that could result in offsite exposures.

References

Hammond et al. 1965. Report of Investigation of Fire in Building 76-77 on October 15, 1965, Part One-Findings. November 3, 1965.

Kittinger, W.D. and C.R. Johnson. Contamination Levels and Decontamination Activities Subsequent to the Incident of October 15, 1965. The Dow Chemical Company, Rocky Flats Plant. October 25, 1965.

Owen, J.B. Description of Accident on 6/12/64. The Dow Chemical Company, Rocky Flats Plant. June 1964.

Owen, J.B. and L.M. Steward. A Historical Summation of Environmental Incidents Affecting Soils at or Near the U.S. AEC Rocky Flats Plant. Dow Chemical Company, Rocky Flats Plant. January 29, 1974

Putzier(1982) Past 30 Years at RFP-Summary of Experiences and Observations at RFP with Emphasis on Health and Safety. Nov 1982.

Status: ❒ Complete.

MEMO

September 26, 1994

From: **John Till**
To: **Distribution**

Subj: **Revised HAP Policy on Interviews**

The attached policy on interviews is a revision to the version sent out during the summer. The changes included reflect ideas from attendees who sat with us at lunch the first day of the meeting. I believe we have a good document that gives anyone a chance to convey information and yet remain anonymous should they desire.

Based on the response we have already encountered to this policy, we believe it is important and must be advertised. As a result, and with some excellent ideas during the luncheon discussion, we plan to distribute this policy to workers and former workers through a number of channels.

Even though the policy now seems to be in good shape, we continue to consider it a fluid document and will revise it as necessary to keep it effective.

HEALTH ADVISORY PANEL POLICY ON INTERVIEWS

Dose reconstruction relies not only on historical records but also on information, either oral or written, given to researchers by those who may have firsthand knowledge and/or scientists, workers, or members of the public who have researched or obtained information that may be useful in the study. This policy provides guidance on interviews conducted as part of the Dose Reconstruction Project for the Rocky Flats Plant.

Health Advisory Panel Policy on Confidentiality of Interviews

The purpose of this policy is to state specific steps that will be taken by The Health Advisory Panel to ensure the confidentiality of individuals who wish to provide information that may be applied in the dose reconstruction for the Rocky Flats Plant.

1. Persons being interviewed will be asked whether or not their names can be cited as the source of information being provided. There are three categories of responses.

(a) *Those persons who do not request to remain anonymous.* These individuals will be asked to indicate this option by signing the acknowledgment statement and agreeing to allow their names to be associated with the information provided.

(b) *Those persons who prefer not to be identified but who understand the potential for other researchers to verify or clarify information.* In an effort to keep the identity of the interviewee confidential, the individual's name will only be recorded on the acknowledgment statement which will be maintained by the Health Advisory Panel. The interviewee's name will be linked to the notes of the interviewer only by time, date, and interviewer's name which will also be recorded on the acknowledgment statement.

It must be understood that the Colorado Department of Public Health and Environment cannot guarantee the confidentiality of the interviewee because of freedom of information generally associated with conducting public research. However, all reasonable steps will be taken to do so.

(c) *Those persons who wish to remain anonymous* . These individuals will note this option on the interview statement form, but will not sign the form. No record of the individual's name will be recorded, only the fact that the interview was conducted and that the interviewee wanted to remain anonymous. Anonymous interviews may be conducted on or off the Rocky Flats Plant Site, at the option of the interviewee. It may be preferable to some individuals to be interviewed by telephone and remain anonymous.

Although individuals may wish to remain anonymous using this option , it is possible that the interviewer could be asked to give a name under oath. If the name can be recalled, then it would become known who the interviewee was. This event, however, is very unlikely in our opinion.

It must be recognized that information provided by individuals who wish to remain anonymous may be of limited value in the study, For example, if a researcher other than the interviewer wishes to verify or clarify data that are provided during an interview, this would not be possible. On the other hand, a person should have the right to anonymity if she or he desires.

Health Advisory Panel Policy on Notes Taken During An Interview

It is crucial that information recorded during an interview be accurate and understandable to both the interviewer and the interviewee. In order to minimize the possibility of misinterpretation of information, the following measure will be taken.

Individuals will be given an opportunity to review the interviewer's notes at the end of the interview. If information has not been summarized accurately, the interviewee should inform the interviewer at that time, and the information will then be corrected. If the interview contains classified or sensitive information and this is recorded in notes, the notes must be reviewed by a classification expert before they can be made public. (See policy on classified information that follows.)

Health Advisory Panel Policy on Copying Documents Offered by the Public

Often in dose reconstruction, members of the public or private researchers have information that is useful to the study. It should be the responsibility of the project staff to make sure these records, when offered, are considered for use, that their integrity is protected, and that they are promptly returned to the owner.

When documents are offered for use in the study, they will be copied expeditiously and the originals will be retained by the owner. The process of copying, including costs of copying, will be mutually agreed upon by the owner of the records and a representative of the study before copies are made. Payment for copying is normally the responsibility of the study unless the owner of records wishes to provide copies at his or her own expense.

Health Advisory Panel Policy on Sensitive or Classified Information Obtained During Interviews

Sensitive or classified information must always be protected. Ordinarily this type of information would not be required in dose reconstruction and the interviewer must be careful not to record data unless they are applicable to the dose reconstruction study.

1. Sensitive or classified information can only be collected or divulged by individuals with appropriate clearances.

2. Prior to an interview, the interviewer should caution the interviewee about discussing any information that is classified. Should the interviewee have classified information believed to be useful to the study, two options are available for conducting the interview: (1) the interview will be conducted on site; or (2) the interviewer will work with the CDPHE and DOE to establish a secure location off site where the interview can be undertaken.

3. Notes resulting from an interview will be reviewed by a classification office of the Department of Energy. Should the interviewee be concerned about information being discussed and possible retribution because of this review process, this concern should be noted. In this case, CDPHE and *RAC* personnel will seek clearance of the information from a classification expert at another DOE site. This arrangement will be worked out prior to the interview.

4. In situations where notes are considered to contain classified or sensitive material, the notes will be shown to the interviewee once clearance has been obtained. The interviewee will approve the cleared notes before they will be used in the study.

Health Advisory Panel Policy on Location of Interviews

1. The location of interviews may be on site or off site depending on the wish of the interviewee. If conducted off site and at any location other than an approved secure location, no classified information will be discussed.

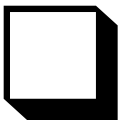
ACKNOWLEDGMENT STATEMENT ON HEALTH ADVISORY PANEL INTERVIEW POLICY

This statement indicates the interviewee has read and understands the Health Advisory Panel Policy on Interviews for the Rocky Flats Plant Dose Reconstruction Project. The interviewee is requested to read, then select by initialing (option a and b only), and sign the following statement (option a and b only) prior to the interview.

SELECT ONE OPTION

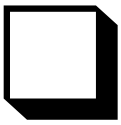
(a) My name may be released as the source of the information obtained during this interview.

Initials



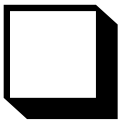
(b) Although I recognize my name may become known due to freedom of information requests, I request the Health Advisory Panel not use my name except to verify or clarify information given during the interview.

Initials



(c) I wish to remain anonymous.

Mark with an "X"



Interviewee signature and date _____

{Note, applies to (a) and (b) only}

Interviewer signature _____

Time of interview _____

Date of interview _____

Location of interview _____

Scinta, inc.
Consultants in Radiation Protection (Scientific, Nuclear & Technical Activities) (301) 593-94

BIBLIOGRAPHIC SEARCH
RISK FACTORS FOR
BERYLLIUM
PLUTONIUM
CHLORINATED HYDROCARBONS

[Title Page & Table of Contents only. Full report available from RAC (Kathleen Meyer, 970 229 0828)]

DECEMBER 1993

2421 Homestead Drive, Silver Spring, MD 20902

Scienta, inc.

Consultants in Radiation Protection (Scientific, Nuclear & Technical Activities) (301) 5

December 6, 1993

John Till, Ph.D.
President RAC
Neeses, SC

Dear John:

Attached is a "Bibliographic Search - Risk Factors for Beryllium, Plutonium and Chlorinated Hydrocarbons." For the most part the data bases searched were those of the National Medical Library(NLM), although in the cases of Beryllium and Plutonium "HP Quest"™ data bases were also employed. These data bases, the search "engines," and search procedures are outlined in Appendices A and B.

In the case of the NLM, searches extended back to 1966 and include material on environmental, clinical and occupational toxicology. For "HP Quest"™ the dates for each journal searched are noted in the appendix. The original material retrieved was about twice the volume of the final document. I reviewed each entry and "vetted" those that were not, in my opinion, relevant to environmental risk.

Abbreviations found in the references are noted in Appendix C.

Appendix D was obtained from the National Technical Information Service and is a recent "Published Search" on "The Toxicity of Beryllium."

The material is organized in alphabetical order by first author for each subject heading. Chlorinated hydrocarbons are broken down into sub-headings for each of the materials identified at Rocky Flats. Following each group of references from the literature, are (if available), synopses of alternative designations for the material, and toxicity, carcinogenicity, and mutagenicity data from CHEMLINE, HSDB-HTOX, CRIIS and RTECS. In the case of Beryllium, an article and research report appeared in a recent "Science" and I took the liberty of reproducing them with proper citation. If major reproduction is necessary, please contact the magazine to obtain copyright permission.

A literature search is the initial step for evaluation of risk. Abstracts included in the document provide a broad understanding of the action and hazards of these substances. Computer files of the body of this document are available.

Sincerely,

Bernard Shleien, Pharm.D.
Certified Health Physicist, ABHP, FAPHA

2421 Homestead Drive, Silver Spring, MD 20902

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MJP — *Risk Assessment, Inc.*

4 January 1994

W. Gale Biggs, Ph.D.
W. GALE BIGGS ASSOCIATES
P. O. Box 3344
Boulder, Colorado 80307–3344

Dear Gale:

Enclosed is a copy of the handout for a presentation that I made at the December meeting of the Health Advisory Panel in Denver. The results presented are preliminary. I believe that the particle size distributions of airborne plutonium that have been measured by various people may be of interest to you. We are continuing to search for additional particle size information. I believe that before long the State will report size distribution data for plutonium in environmental air samples (and perhaps for americium as well).

All of the 1973 measurements were primarily focused on particles resuspended from the vicinity of the 903 Pad. Airborne plutonium was associated with airborne dust particles having a broad range of aerodynamic diameters. The nuclear track measurements on the air filter sections showed that the physical diameters of the Pu particles themselves were relatively small. The behavior of the airborne particles would be dominated by the much more massive stable particle to which the Pu was attached.

Plutonium particles in effluent air were also evaluated using the nuclear track techniques and were found to have small physical diameters, under 0.1 μm. However, the aerodynamic diameter of these particles is about 0.3 μm — the size one would expect to find downstream of a HEPA filter. I have looked at results of a recent attempt to measure effluent particle size. Unfortunately (from the point of view of the analysis) concentrations in effluent air were very low and there seemed to be few measurements in which Pu was actually detected. I will examine the measurement results further when I receive a copy of the report.

One of the conclusions from the data that I have seen so far is that there has been a broad range of sizes of Pu-bearing particles observed in the environment. The graphic that you have used showing only very small and very large particles transporting airborne Pu does not appear to me to be consistent with these field measurements. It appears that, contrary to the opinion of the plant staff who provided you with information regarding particle size, the small Pu particles are

P.O. Box 50430, Idaho Falls, ID 83405-0430 Telephone: 208-529-9171
Suite 301, Historic Federal Building, 591 Park Avenue, Idaho Falls, ID 83402

attached to a more normal spectrum of dust particles that become airborne, not just to large pollen and spores.

If you would like to discuss this question further or if you have any other particle size information that we should study, I will be happy to meet with you. I will be in your area for most of the next two weeks and again in February, so we should be able to find a time to get together if you desire. In any case, I will keep you advised of other information that I find.

Yours sincerely,

Paul G. Veillequé

cc: John Till, Normie Morin
cc: Ms. Paula Elofson-Gardine

McGavran Toxicology Consulting, Inc.

841 Harcourt Road • Boise, Idaho 83702
Phone: 208 336-5617 • Fax: 208 336-0045

August 13, 1994

Paula Elofson-Gardine
Environmental Information Network
P.O. Box 280087
Lakewood, CO 80228

Dear Paula:

I am writing in response to your questions about the amount of methyl ethyl ketone (2-butanone) used at Rocky Flats, its inclusion in the ChemRisk evaluation and whether it should be evaluated further as a contaminant of concern.

Chemrisk Task 1 (page 25 of appendix A, March 1991) and Task 2 (page 13, appendix C, June 1991) reports list methyl ethyl ketone in the inventory of priority one chemicals with inventory amounts of 30 kg in 1974 and 68.445 kg in 1988, giving a ratio of the two of 2.2815. Methyl ethyl ketone is also listed as being a component of 'thinner dope and lacquer' at 25 kg in 1988 (middle of the table on page 20 of the Task 2 report). This amount was included in the 68.445 kg total.

Methyl ethyl ketone was subject to the stage two screening calculations in Task 2. It is listed on page 4 of appendix K of the Task 2 report (attached). Because the ratio of allowable to actual quantity estimates was less than one in this stage two screening calculation, methyl ethyl ketone was excluded from the materials recommended for further evaluation by ChemRisk.

Although methyl ethyl ketone is volatile and presents an inhalation hazard, the Chemrisk toxicity criteria value is an oral reference dose. I called Chemrisk for clarification on this, and they said that they used the oral reference dose (RfD) of 0.05 mg/kg/day because it was lower than the reference dose for inhalation of 0.3 mg/kg/day and that the allowable inventory quantity resulting from the inhalation RfD would be nearly 300 times larger than the amount calculated using the oral RfD. The allowable inventory quantity, based on either the oral or inhalation RfD value, is much larger than the actual inventory quantity. Methyl ethyl ketone did not qualify as a 'potential chemical of concern' because the ratios of allowable quantities, based on either oral or inhalation exposure, to actual quantities were

much less than one.

Chemrisk was also asked to verify the accuracy of the 30 and 68 kg amounts, which they did (repository document CH-93).

There is quite a lot of toxicity information on methyl ethyl ketone because it is a component of many household products (aerosolized paints, adhesives, sealers, brush cleaners, varnishes, lacquers, etc.). Methyl ethyl ketone is abused, by inhalation, because of its hypnotic effects, which are actually greater than those of ethanol. However, because it is an irritant, methyl ethyl ketone usually produces irritation of the eyes, nose and mouth that is sharp enough to prevent overexposure under most circumstances.

Another concern is the fact that although methyl ethyl ketone, alone, is a relatively safe solvent and not highly toxic, it has been reported to potentiate the toxicity of other chemicals. In studies on laboratory animals, methyl ethyl ketone potentiates the toxicity of chloroform and carbon tetrachloride to the liver, probably by enhancing the metabolism of these chemicals to toxic intermediates. This potential interaction is not mentioned in the section in the Task 2 report on synergism so I do not know if it was considered. I believe that the synergistic effects are primarily a concern with acute exposures to high levels of the solvents and may not be applicable to chronic exposure to levels we might estimate occurring offsite. The amounts of methyl ethyl ketone released are likely to be too low to have resulted in air concentrations offsite that could have caused health effects, even synergistically with chlorinated organic chemicals like carbon tetrachloride. The interaction of methyl ethyl ketone with these chemicals may be of concern for onsite personnel who worked with both solvents but not for offsite populations. Chloroform and carbon tetrachloride are possible human carcinogens but methyl ethyl ketone has not been reported to potentiate the carcinogenicity of these solvents.

In addition, methyl ethyl ketone is rapidly degraded in the environment. The atmospheric half-life is estimated to be 2.3 days or less.

Based on a review of the toxicity of methyl ethyl ketone, the reference values (for example, the oral and inhalation RfD and 200 ppm threshold limit value for workers), and possible synergistic effects with chlorinated compounds released from the site, I recommend that methyl ethyl ketone not be evaluated further as a material of concern.

If you have any information that suggests larger quantities of methyl ethyl ketone were used at the Rocky Flats Plant, please let us know. Using ChemRisk's approach, amounts greater than 5600 kg may be of concern regarding offsite contamination and I believe that amounts greater than 2000 kg might warrant further evaluation because of possible synergistic interactions.

This is a good example of how one good question can lead to other good questions. I am very glad you asked the question. I hope we can discuss this at the next HAP meeting.

Please call me at (208) 336-5617 if you have any additional concerns or questions about this.

Thank You,

Patricia McGavran

Patricia McGavran

cc: Radiological Assessments Corporation
CDH
Attachment

STATUS REPORT OF DOCUMENT REVIEW FOR THE ROCKY FLATS DOSE RECONSTRUCTION PROJECT

TERROL F. WILSON
SEPTEMBER, 1994

SUMMARY STATEMENT

This report provides a review of the methodology used to search out, locate, identify and retrieve documents deemed important to the Phase II goals of the Rocky Flats Nuclear Weapons Plant Dose Reconstruction Project. Although most documents are obtained via requests from official government repositories, some are generously provided by retired and present employees, researchers not directly affiliated with Rocky Flats contractors, and contributing citizens. Repositories or geographic groupings of repositories are generally treated separately below.

1. DOCUMENTS STORED IN THE WASHINGTON, DC AREA

Documents generated by the Atomic Energy Commission (subsequently ERDA and DOE) relevant to Rocky Flats are stored at several locations in the Washington, DC area. These are: DOE Headquarters in Germantown; at H Street; and at Suitland Maryland. These documents have been generated by various Divisions and Offices, and are under the control of the Records Holding Area and the History Division. Records have been transferred from the various Divisions and Offices to the Records Holding Area for storage and eventual destruction. Prior to destruction of any documents, the document is transferred to the History Division, which may decide to retain control.

Documents retained by the History Division are tracked under the files of individual Secretariat groupings. Secretariat document groups for the years 1948-1957 have been transferred to the National Archives, and are no longer under DOE control. This means that seperate access to these documents must be obtained from the National Archives. DOE's History Division still retains control over documents for the years 1958-1974. The Records Storage Center controls more recent documents.

The following listings of documents have been reviewed:

a) Historian Document Inventory Joblist (559 pages)

b) Biology and Medicine List (1947-1974, 23 pages)

c) Listing of Folders Entitled "Rocky Flats" in History Division (2 pages)

d) Records Holding Area Active Accessions List (128 pages)

e) "H" Street (95 pages)

f) National Archives and Records Administration List (49 pages)

A list of 43 entries was initially selected for examination. An entry may refer to several boxes or one folder in a box. Review of these materials led to the request and reception of about 130 documents. The goal is to complete all reviews in about two months.

2. DOCUMENTS STORED AT EG&G IDAHO

About a dozen formal reports and several file folders with notes and calculations, all having to do with disposal of Rocky Flats wastes at the Idaho National Engineering Laboratory are in RAC hands. The primary documents are a history of buried wastes that was compiled in 1977, and a recent compilation giving their assessment of what is stored as well as buried.

3. ROCKY FLATS AND ALBUQUERQUE OPERATIONS OFFICE RECORDS SEIZED BY THE FBI

The CDPHE attorney is investigating access to these materials. The information is that the total is 950 boxes and most, if not all, are in the U.S. Attorney's Office. A Boulder attorney is reported to have gained access to 64 Grand Jury boxes, an access that has also been requested by CDPHE.

4. BUILDING 881 CLASSIFIED DOCUMENT REVIEW AT ROCKY FLATS PLANT

There are records storage receipts for each box at this repository vault. A systematic search of these descriptive receipts involved reviewing 15 3-ring binders. Approximately 2,100 boxes (all that were in residence) were opened for content verification as compared with receipts. These boxes do contain some unclassified documents in addition to the classified materials. A computer database was developed, by RAC, for tracking each box of classified documents, which included additional entries for specific papers of interest. Fifteen documents have been requested for declassification. We have received reports on both the 1957 and 1969 fires, and have requested all the information relevant to accounting for plutonium involved in the 1957 fire. Also, about 100 unclassified documents have been requested for copying. The systematic search for classified documents has been completed.

5. BUILDING 706 CLASSIFIED LIBRARY VAULT AT ROCKY FLATS PLANT

Several thousand classified documents are to be found in this vault. One of the documents reviewed here was the original classified report on the 1957 fire. Although some other documents of general interest were found, none on plutonium effluent or environmental monitoring could be discovered. The search for classified documents at this location is complete.

6. OTHER ROCKY FLATS SOURCES OF CLASSIFIED DATA

A search of documents classified as Secret Restricted Data has been performed. These include materials relevant to tritium releases and material balance differences. Three documents from T893B Classification Office, 8 from Building 706 Classified Library, 6 from 111 Satellite Accountability Center (SAC), 6 from 460 SAC, 2 from 707 SAC, 4 from 750 Room 200, 10 from 750 Room 102 and 3 from 750 have been reviewed. We have requested that selected classified documents be reviewed for declassification. Examination of documents in these areas has been completed.

7. CHEMRISK OFFICES IN CALIFORNIA

RAC has received all boxes Chemrisk gathered in Phase I of the Dose Reconstruction Project, amounting to an estimated 40 cubic feet. These are all the records Chemrisk considered useful to the work, and include materials from offsite. Included are the Chemrisk work done on the DOTY and EG&G databases. A thorough first review has been made of these Chemrisk boxes, and it is to be considered as a library resource.

8. CHEMRISK, DOTY & ASSOCIATES AND EG&G DATABASES AT ROCKY FLATS PLANT

Searches conducted on these databases have been directed toward a great number of topics including: fires, liquid effluent, accidents, 903 Pad, carbon tetrachloride, soils, stack releases and solar ponds. These databases are an extensive, concentrated repository. To date, about 500 documents have been requested and received. RAC has examined the DOTY and EG&G databases for material added since the Chemrisk reviews.

9. ENVIRONMENTAL MASTER FILE AT ROCKY FLATS PLANT

The Environmental Master File at Rocky Flats Plant is maintained by an employee of Los Alamos, under DOE funding. This group operates the main file at the Plant Site, and another office at East Pearl in Boulder where incoming documents are processed prior to movement to RFP. The Environmental Master File contains a large number of unclassified documents and photographs, sent from Rocky Flats Plant departments and workers, which contain information of value to environmental analyses or problems. Requests for keyword searches of the file are processed, and when done, RAC personnel visit the File room to retrieve materials identified and numbered in the keyword printouts. RAC people examine the documents and make formal letter requests for copies of those deemed useful. To date 6 searches have been conducted and about 195 documents requested and delivered. We are now in the midst of another large search and anticipate the need for 2 or 3 more.

10. FEDERAL RECORDS CENTER AT THE DENVER FEDERAL CENTER

Rocky Flats Plant identifies unclassified documents for shipping to the Federal Records Center. These boxes are held indefinitely, unless there is a designated date after which they can be destroyed. Records receipts are kept in 12 3-ring binders at Trailer 334C at RFP. These receipts, about 725 total, list or summarize box contents and the number of boxes accounted for. The receipts form the basis for formal letter requests to view stipulated boxes at the Federal Records Center. RAC examines the box contents when they have been pulled from storage, and labels all useful documents and boxes for shipment to RFP, where copying takes place after another formal letter request. About 270 boxes have been examined, resulting in copy requests for over 100 documents of about 6 cubic foot volume. Some documents are not clearly distinguished or separated, for example one document may consist of 200 pages of S-Series Air Sample Logs. All receipts have been examined, and all but about 15 of the ordered boxes have been reviewed. We expect to conduct a brief second review of the receipts for an accuracy check and potential final box order before concluding the Federal Records Center search.

11. ROCKY FLATS PUBLIC READING ROOM AT FRONT RANGE COMMUNITY COLLEGE

EG&G maintains a pubic reading room of Rocky Flats related documents at the Front Range Community College Library in Westminster. These unclassified documents consist of official reports, press releases, environmental projects and progress reports. Access to papers can be gained directly from the shelves and copied onsite. A computer database aids in identifying documents via keyword search, a list of which is found next to the computer. The computer is directly available to the researcher. To date, about 40 documents have been copied, and this source may be occasionally revisited for specific searches.

12. THE LEGAL AND ENVIRONMENTAL DATABASE AT ROCKY FLATS

This search continues, as a list of 55 search keywords is currently being processed by EG&G personnel. This search will result in an extensive document list, therefore, RAC people will review the printouts prior to making document requests.

13. EFFLUENT MONITORING RECORDS HELD AT EAST PEARL IN BOULDER

Historic effluent and environmental monitoring files are held by an EG&G employee in Boulder. RAC visited this office and reviewed the files. About 150 documents were requested, via EG&G channels, and have been received. Most deal with monitoring locations, effluent flow information, monitoring results, status and testing of HEPA filters and particle size. This effort is complete.

14. RECORDS, RESEARCH PAPERS AND VERBAL INFORMATION PROVIDED BY OTHER SOURCES

An extensive source of information useful to the Project goals resides in locations other than the government or contractor repositories listed above. A number of documents not found at the above locations has been reviewed, requested and received by RAC. These findings have come through initial solicitation, by RAC, of the sources; by volunteer offerings from the sources; or as a result of interviews. These acquisitions have typically not been conducted systematically. Therefore, this phase will probably be essentially complete when the interview process comes to an end in a few months.

A listing of these sources is given below. If we have neglected to identify any of our sources, please inform us directly so that we can rectify this. We extend our apologies for any omissions.

a) Colorado State University researchers are conducting soil and sediment studies at Rocky Flats and in the Front Range area and have made information available to us

b) Local counties, cities, school districts and airports have provided diverse aid

c) The Citizens Environmental Sampling Committee is conducting a soil study, which will provide unique data

d) The Environmental Information Network has provided documents, verbal information and contacts

e) Colorado Department of Public Health and Environment personnel are providing much technical expertise and documentation

f) Local colleges and univereities have offered assistance in many areas, including sources of weather information

g) Subcontactors and personnel doing work at RFP or pertinent to RFP

h) Independent researchers and experts who have conducted RFP studies

i) Independent citizens who have interests in RFP operations and the outcome of this study

j) Present, former and retired RFP employees who have stepped forward with information

RECORDS TRANSMITTAL AND RECEIPT

Complete and send original and 3 copies of this form to the appropriate Federal Records Center for approval prior to shipment of records. See specific instructions on reverse.

PAGE 1 OF 1 PAGES

1. TO (Complete the address for the records center serving your area as shown in 36 CFR 1228.150)

Federal Records Center
Bldg 48
Denver, Co 80225

5. FROM (Enter the name and complete mailing address of the office retiring the records. The signed receipt of this form will be sent to this address)

EG&G Rocky Flats, Inc.
ROCKY FLATS PLANT
ATTN: RECORDS SERVICES, BLDG. T441A
P. O. BOX 464
GOLDEN, CO 80402-0464

2. AGENCY TRANSFER AUTHORIZATION — TRANSFERRING AGENCY OFFICIAL (Signature and title): Brian Rogers for E.J. Bernal Records Managment Mgr — DATE: 04/08/91

3. AGENCY CONTACT — TRANSFERRING AGENCY LIAISON OFFICIAL (Name, office and telephone No.): Brian Rogers Records Clerk 966-5643

4. RECORDS CENTER RECEIPT — RECORDS RECEIVED BY (Signature and title): Mark Rogers — DATE: MAY 06 1991

Fold Line

RECORDS DATA

ACCESSION NUMBER: RG (a)	FY (b)	NUMBER (c)	VOLUME (in ft) (d)	AGENCY BOX NUMBERS (e)	SERIES DESCRIPTION (with inclusive dates of records) (f)	RESTRICTION (g)	DISPOSAL AUTHORITY (Schedule and item number) (h)	DISPOSAL DATE (i)	COMPLETED BY RECORDS CENTER: LOCATION (j)	SHELF PLAN (k)	CONT. TYPE (l)	AUTO. DISP. (m)
34	91	0053	1	1/1	ENVIROMENTAL CONTAMINATION MEASUREMENT RECORDS SITE SURVEYS FOR 1974, 1975, 1979	W	DOE 1324.2a 1,8f Perm offer to Archives in 25 years	PERM	721614	S	P	PJ

NSN 7540-00-634-4093

135-107

Standard Form 135 (Rev. 7-85)
Prescribed by NARA
36 CFR 1228.152

Name: Radiological Records | Org Code 15031 | Ext. | Bldg 123 | Date 4-4-91 | No. 1048
(NO ABBREVIATIONS)

Individual Submitting Records to Storage: Debbie Poland Ext. 7204 Managers name: D. A. Weber

Schedule/Item Number: 67F Disposal Date: Perm Retention period of: Permanent Yrs. Managers Signature: [signature]

SHADED AREA FOR RECORD SERVICES ONLY

Accession: [illegible]-91-0033 Received in Storage by: [signature] Date: [illegible]

Make One Entry For Each Document Accountable System (DAS) Document | Use Bill of Material Nomenclature

Document No. and Description of Records	Page/Ct.	Copy/Series	CLS	Custodian Emp. No.	Date/Last Entry	Program	Part Type	Serial No.
Environmental Contamination Measurement Records								
Site Survey			U	515528	1974			
Site Survey					1975			
Site Survey					1979			

REVIEWED FOR CLASSIFICATION/UCNI
By V. A. Muenchow [signature]
Date

DO NOT DESTROY THIS RECEIPT UNTIL NOTIFICATION OF RECORDS DISPOSAL

RF-440 (Rev. 3/90) White - Record Storage Sign - Send Document Control Blue - Storage Sign - Return to Originator Goldenrod - Originators Suspense Copy Yellow - Record Storage F

[redacted] BOX TRACKING INPUT SCREEN

Box Number: 326-76A-203 1/2 Classified Box Y/N ? U

Bldg: 334D Location: BEF

Reviewer: WF Review Date: 7/14/94 Date Range: 11/13/57 to 2/20/59

Box Opened Y/N ? Y Shipping No.: 704017

Subject: Kelly 771 shift log - Randiation

Contains useful information Y/N ? Y

[redacted] RECORD INPUT SCREEN

RAC # Bldg Location

Box No. Reviewer Review Date / /

Document Date / / / / Author

Report/Journal

Title

..g. Org. Category 3 Approx. Pgs.

Radionuclides | Chemicals | Keywords Scan # Was Classified Y/N ?

Comments: just after '57 fire

LONGVIEW ENVIRONMENTAL
Terrol F. Winsor, PhD
(303) 828-4514, FAX (303) 828-3620
4100 North 119th Street, Lafayette, Colorado 80026

DOC.ID:BAGJUN18/94TW

June 18, 1994

VIA TELECOPY 966-4987 AND 966-4016

Loretta Dolan and Annie Morris
EG&G Rocky Flats
Rocky Flats Plant
P.O. Box 464
Golden, Colorado 80404

Subject: Request for copies of unclassified documents from Federal Records Center Boxes

Dear Ms. Dolan:

On behalf of Radiological Assessments Corporation, I am requesting copies of the following non-classified documents for the Phase II portion of the Rocky Flats Dose Reconstruction Project. These were in boxes I examined at the Federal Records Center June 14 and 15, 1994. Please note that I have tabbed the documents to be copied. Also, I have affixed to each of those documents, a sheet of paper labled "box tracking input screen". I would greatly appreciate your attaching these sheets to the document copy, so that I have accurate record of the identity of the copied document.

To be copied:

From box 434-93-0024, box 2 of 17
exhaust duct sampling
hand entered S series air sample data sheets
building 707-707A room exhaust, hand entered data

From box 434-92-0059, box 12 of 18
sediment core samples raw data, D-1 pond

From box 434-91-0033, box 1 of 1
1974 Site survey
1975 Site survey
1979 Site survey

From box 434-94-0039, box 1 of 1
Carl Johnson letters to Robbins
Carl Johnson letters re: annual limits, etc.

From box 434-93-0109, box 1 of 1
1 page, 1/20/58, air sample recor card

From box 434-94-0040, box 1 of 1
air contamination and continuous air monitor report
historical files, 771 outfall, with map
landfill findings
sample counting and statistics

From box 434-94-0035, box 3 of 4
air sample records, 71 building, about 20 cards

I can fetch the copies upon completion. We greatly appreciate your help in the review process. Thank you.

Sincerely,

Terrol F. Winsor
Longview Environmental
Radiological Assessments Corporation

cc:Judy Krumm-DOE
Mary Hammack-DOE

Title: Site Survey

Re done

ROCKY FLATS EMF/RF/MC DATABASE SUMMARY DISPLAY

ICN	Date	Title
755	19750708	ATMOSPHERIC RELEASE ADVISORY CAPABILITY (ARAC) SITE SURVEY AT ROCKY FLATS PLANT*
1328	19750311	ROCKY FLATS SITE SURVEY SCHEDULE Survey of Site in 1970s
1329	19741206	CARGO CARRIER AREA AND SITE SURVEY
1330	19741017	CARGO CARRIER AREA AND SITE SURVEY
1331	19750102	CARGO CARRIER AREA AND SITE SURVEY SCHEDULE AND STATUS
3490	19770200	SAFEGUARDS AND SITE SURVEY UPGRADING missing
4096	19730424	SITE SURVEY JEEP ROUTES duplicate
4106	19600314	HEALTH PHYSICS - SITE SURVEY - 1960 order
~~4107~~	~~19600422~~	~~SITE SURVEY SAMPLING PROGRAM~~ order
4108	19600318	HEALTH PHYSICS - - SITE SURVEY - - 1960 order
4109	19591214	1959 SITE SURVEY SUMMARY -- OFF-SITE SAMPLES Requested
~~4214~~	~~19570702~~	~~ANALYSIS OF SITE SURVEY DATA~~
4814	19730416	SITE SURVEY LAB AIR SAMPLES Sample card - no data
~~6144~~	~~19610419~~	~~AN ANALYSIS OF SITE SURVEY VEGETATION SAMPLES~~
6519	19570204	SITE SURVEY MONTHLY REPORTS 1957 FROM 2/4/57 THRU 1/8/58*
6520	19760906	SITE SURVEY MONTHLY PROGRESS REPORT * AUGUST THRU DECEMBER 1956 DATED 9/6/56 TO 1/18/57
6521	19560201	MONTHLY PROGRESS REPORT FOR 1955 SITE SURVEY FROM 2/1/55 THRY 1/5/56
6522	19540201	SITE SURVEY MONTHLY PROGRESS REPORT FOR 1954 DATED FROM 2/1/54 THRU 1/5/55
6523	19520711	SITE SURVEY MONTHLY PROGRESS REPORT 1953-1952 - JULY 1952 THRU DECEMBER 1953 DATED FROM 07/31/52 THRU 1/8/54
6524	00000000	SITE SURVEY LOCATIONS AND ANALYSIS*
6525	19520000	SITE SURVEY LOCATIONS & ANALYSIS - WATER SAMPLES FROM 1952 THRU 1971*
6526	19520000	SITE SURVEY LOCATIONS & ANALYSES - WATER SAMPLES DATED FRO 1952 THRU 1969*
6527	19520000	SITE SURVEY LOCATIONS & ANALYSES - POND SAMPLES DATED FROM 1952 TJRU 1972
6528	19520000	SITE SURVEY LOCATIONS & ANALYSES - RESERVOIR SAMPLES DATED FROM 1952 THRU 1972
6529	19520000	SITE SURVEY LOCATIONS & ANALYSES-TAP WATER SAMPLES DATED FROM 1952 THRU 1972
6530	00000000	SITE SURVEY LOCATIONS & ANALYSES-VEGETATIONS SAMPLES*
6531	19520000	SITE SURVEY LOCATIONS & ANALYSES-SPECIAL VEGETATION SAMPLES* DATED 1952 THRU 1971
6532	19530000	SITE SURVEY LOCATIONS & ANALYSES - VEGATATION DATED 1953 THRU 1971
6534	19520000	SITE SURVEY LOCATIONS & ANALYSES - VEGETATION SAMPLES DATE FROM 1952 THRU 1971
6535	19520000	SITE SURVEY LOCATIONS & ANALYSES-VEGETATION SAMPLES* DATED 1952 THRU 1971
6536	19570000	SITE SURVEY LOCATIONS & ANALYSES-SOIL AND FALL OUT* DATED 1957 THRU 1972 requested
6537	19630000	SITE SURVEY LOCATIONS & ANALYSES-FALLOUT TRAYS* DATED 1963 THRU 1972 requested
6538	19700000	SITE SURVEY LOCATIONS & ANALYSES-STACK RELEASE AIR SAMPLES DATED 1970 THRU 1971
6539	19670000	SITE SURVEY-1967 AND 1968
6540	19660000	SITE SURVEY LOG BOOK 1966
6541	19650000	SITE SURVEY 1965 AND 1960
6542	19640000	SITE SURVEY LOG BOOK 1964 AND 1965
6543	19570000	SITE SURVEY PULSE HEIGHT ANALYSES 1957-58*